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EXERCISES.

45

LET O, O' be the centres, r, R the radii of the inscribed and circumscribed circles of a triangle ABC; also let A', B', C' be the feet of the perpendiculars from the vertices on the opposite sides, I their intersection and ρ the radius of the circle inscribed in $A'B'C'$. Prove

$$OI^2 = 2r^2 - 2R\rho,$$
$$O'I^2 = R^2 - 4R\rho.$$

[*Wm. E. Heal.*]

46

FIND an equation that shall express approximately the surface of an egg shell. By means of the variations of not more than three constants in the equation, express the various sizes and shapes of eggs. [*H. A. Newton.*]

47

Two bulls arriving on opposite banks of a river a rods wide, plunge into the water at the same instant and swim toward each other until they meet. One bull can swim m miles and the other n $(m > n)$ miles an hour in still water, and the velocity of the river is v miles an hour. Required the equation to the curve described and the distance swam by each bull, and the location of the point of meeting. [*Artemas Martin.*]

48

IN the angle A a point P is given. Construct a triangle ABC whose base BC shall contain P while the sum of the sides AB and AC equals a given length. [*W. M. Thornton.*]

49

A BEAD is placed on a smooth circular wire ring which receives a given angular velocity in its own plane about a point of its circumference: prove that the initial velocity of the bead is half that of a point of the wire the distance of which from the bead equals that of the bead from the fixed point. [*William Hoover.*]

50

ABC is an equilateral triangle inscribed in a circle. From any point P within the angle BAC, straight lines PA, PB, PC are drawn. Show, *geometrically*, that $PB + PC - PA$ is a minimum when P is on the circumference of the circle about ABC. [*R. D. Bohannan.*]